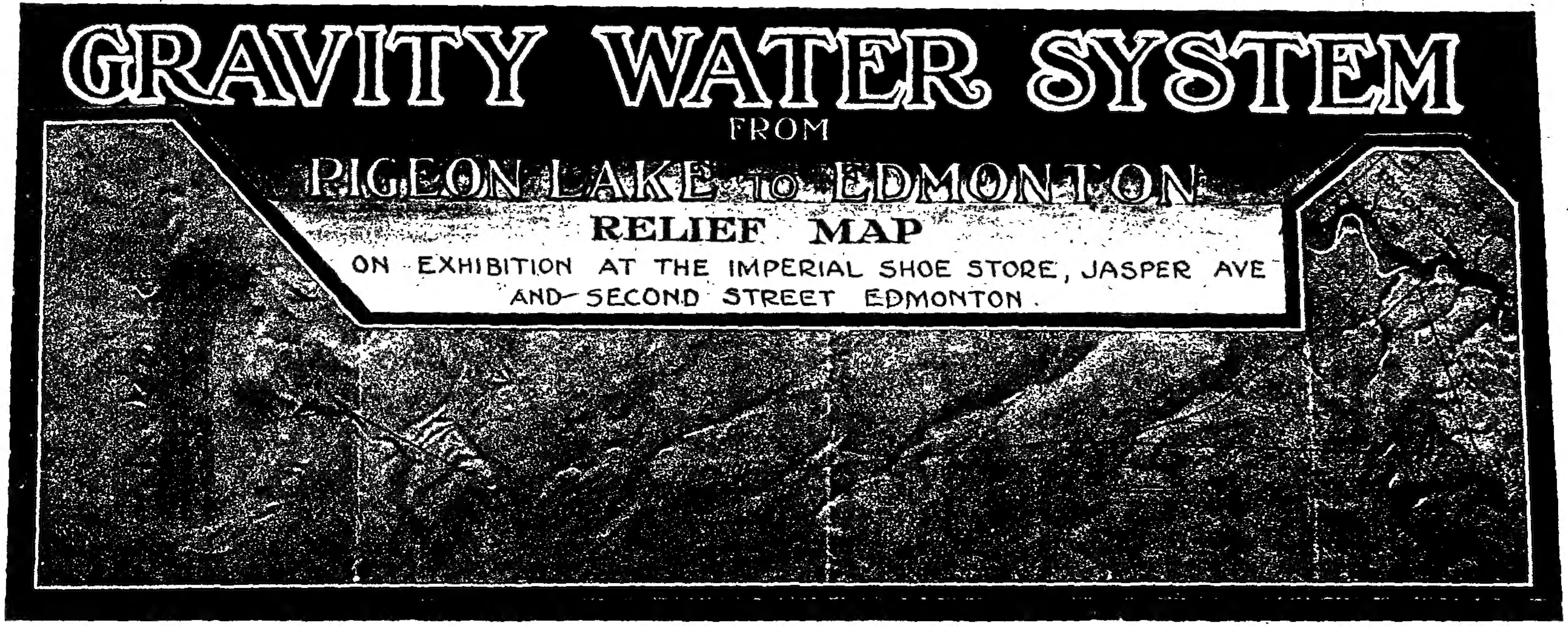
REPORTS OF EXPERTS
ON
EDMONTON WATER SUPPLY

PRINCIPALLY
PIGEON LAKE SCHEME

1909


GRAVITY WATER SYSTEM
FROM
PIGEON LAKE to EDMONTON
RELIEF MAP
ON EXHIBITION AT THE IMPERIAL SHOE STORE, JASPER AVE
AND SECOND STREET EDMONTON.

63.4.5/3

TO THE CITIZENS OF EDMONTON:—

The purpose of this pamphlet is to put before you the reports of the experts who have enquired into the suitability of Pigeon Lake as a source of water supply for the City of Edmonton. I feel confident that upon the citizens generally being made aware of the facts a sane and enlightened public opinion will demand the adoption by the municipality of some plan that will ensure the City a continuous and adequate supply of pure water from this, the only pure water reservoir within available distance of Edmonton. The problem of the water supply of this city is so pressing and the necessity for immediate action so urgent both in the interests of public health and of protection to property that no effort should be spared by anyone having the interests of the city and its future development at heart to bring about an early adoption of such a policy. The fatal procrastination in dealing with this all important matter, the putting up with temporary and make-shift expedients at wasteful expense, will cease as soon, but not until, the public generally is made aware of the facts. It is in order to bring these facts to your notice that I have collated the subjoined reports.

Yours faithfully,

Frank M. Gray

8761

EDMONTON'S WATER SUPPLY PROBLEM

Present System of Pumping Can Never Be Satisfactory—It is Both Inadequate and Wasteful—Provincial Sanitary Engineer Owens Presents Exhaustive Report to City Council Dealing With Question—Gravity System the Easiest and Best Solution.

From the "Bulletin," February 3rd, 1909

A VERY important report was read at the city council meeting last evening from R. B. Owens, provincial sanitary engineer, on the question of the supply of water for the use of the city of Edmonton. The report contains a vast amount of valuable information that will be of considerable use to the city in deciding on the question of the source of water supply for the city. The report will be retained for reference and a resolution thanking Mr. Owens for the information was passed by the council.

Commissioner McNaughton in referring to the report explained that the reason for the large additions to the present pumping plant in the city mentioned in the report, was to safeguard the city in case of a breakdown or serious fire, as well as to supply the city with ample water for daily consumption. With regard to the three systems recommended, the gravity, partial gravity and pumping systems, the commissioners felt that it was not wise to enter into any of the schemes proposed without first carefully investigating the water supply of the lakes mentioned as possible sources of the water supply for the city. Mr. McNaughton commented on the valuable nature of the information contained in Mr. Owens' report and suggested that a resolution of thanks be passed by the council. He also advocated asking Mr. Owens to favor the city with any information he might have regarding the source of supply, precipitation, quality of the water and other matters pertaining to the water in the lakes around Edmonton suggested as a source of water supply for the city.

Mr. Owens' Report.

The report of Mr. Owens was as follows:

I have the honor to comply with the request contained in your resolution of the 12th inst. with reference to obtaining from me suggestions on the extension of the city waterworks, and on the sources of water supply in this district. I think we may safely assume that the future of the city of Edmonton is assured, and therefore I would suggest that a scheme for permanent waterworks be now considered, in order to avoid, as far as possible, spending money on temporary works.

The scheme should provide for a prospective population of at least five or six times the present, and should include all the works necessary to ensure a plentiful supply of pure water for domestic purposes, and to ensure a constant pressure for fire protection purposes.

I shall discuss the subject under the five headings as follows:

(1) The present proposed extension.
(2) The proposed extension to the Gibbons property.
(3) A pumping system.
(4) A partial gravity system.
(5) A total gravity system.

(1) The Present Proposed Extension.

I am not in a position to say whether or not the present proposed extension is absolutely necessary, but there are a few points which seem to me ought to be very carefully considered before entering on this latest so-called extension, which admittedly is not the installation of a section of a complete and permanent works, but is at best but a new patch on an old works, and is being laid down we are told, because it is an absolute necessity.

Previous to 1st October, 1908, or just four months ago, one pump of one and one-half million gallons capacity, and one pump of 600,000 gallons capacity, or practically, let us say two million gallons per day was our capacity. This, four montsh ago, was increased to five millions by the addition of a three million gallon pump, and now we are told

we require an additional six million gallon pump, making our pumping capacity eleven million gallons per day. The reason given is that we are using three million imperial gallons per day, i.e., or a city of 20,000 inhabitants, 150 imperial gallons per head, or about 750 gallons per household per day, yet the average per head in the United Kingdom is only 30 gallons, which includes water for industrial purposes and waste, and in the United States 100 U.S. gallons, i.e., 83 imperial gallons is considered an exceedingly large allowance. This also includes for industrial purposes and waste.

P. Bryce, M.A., M.D., who for twenty years was medical health officer for Ontario, advises me that from his twenty years experience he has come to the con lusion that forty gallons per head per day is an ample allowance for domestic use, industrial purposes and waste, in Canadian cities. Suppose, then, we say that for use, waste and industrial purposes, we allow seventy-five imperial gallons per head per day, which in my opinion is a liberal allowance, the quantity for 20,000 people would mean one and one-half million gallons per day. What then is becoming of the remaining one and one-half millions per day? Is it possible we are deceiving ourselves about the quantity we are pumping? Unfortunately we have no meter at our works, absolutely no means of knowing how much we pump, or wuat is the "slip" of our pumps. Thus the efficiency of our machinery is an unknown quantity, as also is the cost of our water per million gallons.

Strathcona Service Better.

Mr. A. J McLean, city engineer of Strathcona, has furnished me with a report showing that Strathcona pumps 139,932 imperial gallons per day to her 4,000 inhabitants, or approximately at the rate of 699,660 gallons per 20,000 people, i.e., a rate of 35 imperial gallons per head, including use, waste and manufacturing purposes, and that her cost of pumping per million imperial gallons is $126.

Now the average cost of water as supplied to twenty-two cities on this continent is $110.50 per million gallons, and as we supply the Canadian Northern railway at what we call cost price, viz.: six cents per hundred cubic feet, i.e., $96.30 per million gallons, we may safely assume that it is costing us at least $110.50 per million imperial gallons to supply our water. So that, on this assumption, if we are wasting one and one-half million per day, we are wasting $165.75 per day, or $60,500 per year, which amount is just about equal to the amount of our expenditure on water during the past twelve months, viz.: $60,000, which would seem to indicate that we are either pumping only about one and one-half million gallons per day, or we are supplying water at one-half what it costs other people to supply it for. I fear the latter is impossible. If the former is the case, what do we want with a pumping capacity of eleven million gallons per day?

The Question of Pumps.

If we require any increase, it seems to me it is an increase in the number of pumps, in order to provide against possible breakdowns at times of fire, and that could be best obtained by o dering two three-million gallon pumps instead of one six million. One three million, in addition to the one and one-half and one three million, which we have, will give about the same factor of safety as one additional six million. Seeing we do not need eleven millions, and could not get it if we did, as we have only proposed providing purification plant for four millions, and seeing this so-called extension is of so temporary a nature that the proposed filters are to be wooden butts, instead of permanent cement filters, that we may the more readily take them eight miles up the river when the time comes, if ever, that we are to go higher up, it seems to me two threes would be handier to move than one six, in that we could do without one three, more safely, having a second one to fall back on, than we could do without our six. Taking all the existing circumstances into consideration, if an addition must be made, it would seem that one three is quite sufficient, but that two threes would be better than one six, and easier to sell should we wish to dispose of them later, as we might.

The Matter of Purification.

With reference to purification, as you are aware, I have already suggested that the following should be inserted in the agreement which the city makes with the manufacturer supplying the filters.

(1) That the manufacturer provide a simple method of testing for alkalinity in the raw water, free alum, free sulphuric acid and other injurious chemicals in the filtered water, such test to be one that can be readily performed by an intelligent operator.

(2) That the manufacturer guarantee that there shall not be at any time in the effluent from the filters any decomposed coagulent, free sulphuric acid or other harmful chemical.

(3) That the manufacturer provide and instal an appartaus to control the flow of the effluent in order to prevent the operation of the filters in excess of their rated capacity.

(4) That the manufacturer shall analyze the raw water, decide the approximate amount of alum that should be used at the various seasons of the year, such amount to be, if possible, made more exact by the test as outlined in clause (1).

(5) That the manufacturer make provision by means of which artificial alkalinity can be added when the natural alkalinity is not enough to admit of alum being added in sufficient quantity to produce complete coagulation and sedimentation.

(6) That the manufacturer provide an expert operator during the spring of 1909, and until a suitable local man can be trained to the work.

Filters No Good He Thinks.

Yet with all these and the other guarantees contained in the agreement with the vendor of these filters there is a doubt in my mind if the whole lot are worth the paper they are written on, as it is so hard to prove that the instructions of the vendor were accurately carried out, and the departure from such, even in the slightest detail without written authority, would be sufficient to invalidate any claim which the council might think they had against him. One clause in the agreement is as follows: "The above guarantee as to the quantity and quality of the filtered water is made conditional that the filters be operated according to the company's instructions, which are, in brief, that the purchaser use, or cause to be used, sufficient quantity of coagulent, that the rated capacity of the filters be not exceeded, and that the filters be cleaned as often as the condition of the raw or applied water may necessitate, and with the further condition, that the filter plant be operated in connection with a subsidence basin, providing a period of coagulation and subsidence of not less than five (5) hours, and with the further provision that the coagulating and subsidence basin be arranged substantially as shown on company's blue print No. 1205."

The Methods of Purification.

Roughly outlined, the plan of purification in these filters consists in adding to the raw water a dose of common alum, averaging between a quarter and a half of a grain per gallon (the vendor proposed to add one and one-half grains to our water), and allowing coagulation to take place, and then admitting the water to the filter, which in this case is a cylinder of wood, three quarters full of uniformly fine sand. The carbonates present in the water decompose the alum, with the formation of a flocculent precipitate of aluminium hydrate, jelly-like in appearance. This aluminium hydrate entangles the suspended matter, bacteria included, and deposits the same on the surface of the sand, whence it is removed and driven into the waste pipe by a reverse current of filtered water at the time of cleaning the filter. In properly-managed filters of this type, no alum should (or, at most, a trace), reach the filtrate, for only such a quantity is admitted to the water as will be decomposed by the amount of carbonates present.

The proper management, which includes the admitting of the proper quantity of alum, and the careful and frequent analysis of the raw water to determine this quantity, is an important consideration for us.

The addition of a chemical to a public water supply, whether in the form of a precipitate or coagulent, is not recommended, except under absolute necessity.

A drinking water requiring a large amount of "manufacturing" before distribution is to be looked upon with suspicion.

A certain definite amount of the coagulent must be used in the coagulation of a raw water of a given turbidity. If the quantity used be insufficient, no precipitate willl be formed, whilst an excess will not only be wastelul but may be dangerous to the purity of the water.

In my opinion, for Edmonton, this system is of the nature of a four million gallon per day experimental station.

(2) The Proposed Extension to the Gibbons' Property.

A waterworks installed on this property would necessitate either a mechanical filtration plant, including the use of a coagulent such as that just referred to, or large sedimentation basins, capable of holding fifteen days' supply and filters for further purifying the water. The cost of the latter scheme laid down on the Gibbons' property would be excessive. In my opinion, I do not think the Gibbons' property a suitable site or location for the establishment of a waterworks plant.

(3) A Pumping System.

In the pumping system which I would recommend, were I about to recommend a pumping system at all (the source of supply being necessarily the river), I would include special provisions for purification. The best system of purification yet known to engineers is one in which the main feature is natural sedimentation; filtration taking a minor position, and being used merely as a refinement to make more sure the work done by sedimentation. If this is so, one naturally might ask the question why so few cities adopt sedimentation as their main feature. The answer to that is simply that the cost of construction of sedimentation basins to hold three weeks' supply is so excessive, that they cannot afford it, and must therefore resort to quicker methods, which, of course mean cheaper methods, but cities such as London, that ha e the money and wish to have the best possible potable water that can be produced from raw river water, have proved to the entire satisfaction of the public health, medical and engineering professions that three weeks sedimentation of river water, combined with moderate filtration of the effluent is the most satisfactory method yet known.

London's Pure Water.

London, England, as we all know, has depended on this method for very many years to render the filthy water of the Thames a safe drinking water, and London's death rate is 15 per 1,000, or less than any city in the United Kingdom of over 200,000 inhabitants, except Bristol and Leicester. So excellent is the method of sedimentation that for many years engineers have been trying to devise a mechanical method whereby all the advantages of sedimentation can be had without its accompanying disadvantage of excessive cost. This method has taken the form of what is called the mechanical filtration, which in most, but not all cases, is really chemical precipitation or coagulation to bring about rapid sedimentation, thus requiring only a very small tank instead of an extremely large reservoir. The method adopted in this case is usually the adding of common alum to the raw water in a basin allowing a short time for coagulation, etc., as already described.

But why should we take any risks with regard to the quality of our potable water, or submit to any experimental methods being imposed on us, seeing we have what we want, where we want it, in the nature of some splendid ravines abutting on the river one of which properly dammed, and the natural drainage bye-passed, would make a very cheap and e cellent sedimentation reservoir, capable of holding three to six weeks' supply; into this ravine could be pumped the river water, and immediately below the ravine could be placed a class of filter to which I shall refer later, which would render the river water excellent, excepting in the matter of hardness, which cannot without spec'al treatment be removed. To these filters the water would flow by gravity from the sedimentation reservoir, and from these to a clear water basin, whence it would be pumped by two lines of pipe to the city as at present.

(4) A Partial Gravity System.

For this method also we have what we want where we want it in the form of the high ground known as the Beaver Hills, with elevations of two hundred to three hundred feet above the highest point in the city, having various natural lakes and basins, one of which could be converted into a sedimentation reservoir, capable of holding from three to six weeks' supply. Two lines of pipe could be laid from the present power house, across the river and up through Strathcona to a valve shaft placed alongside and having a connection with this reservoir, one line could be used as a force main and the other as a delivery main, and for reasons which will appear later these might be two lines of 30 inch pipe and a little below these reservoirs the filters as mentioned hereinafter would be placed. With our reservoir at an elevation of say two hundred and forty feet very suitable hydraulic pressures could be obtained at the highest point in the city. Should our pumps break down we have a reserve supply of three to six weeks in our reservoir. Should either the force or delivery main burst we have the other to fall back on, as by an arrangement of valves they can be made interchangeable. Meanwhile of course we would cease pumping and use our reserve supply.

This system could be designed and constructed this season so that the citizens would have but one more muddy period to endure, which they will most likely have in any case.

(5) A Total Gravity System.

For this system also nature has equipped us liberally. From the valve shaft aforementioned I would continue one line of 33 in. pipe across country following the undulations of the ground to a valve shaft situated alongside Wizard Lake, where we have a natural storage reservoir at an elevation of three hundred and eighty feet above the highest point

in the city, of about two square miles in area, and depths up to twenty feet with steep banks, sandy bottom and good water, and then right on towards Pigeon Lake and ultimately, by means of a tunnel, right through to the lake where we have a sheet of good water over thirty-seven square miles in area, fairly deep, with a large catchment area.

The water of the lake is of excellent quality, the very little organic vegetable matter which it contains, I would propose utterly removing from it by means of speci l automatic compressed air and oxidizing waterworks filters, concerning which Dr. John C. Thresh, D.Sc., D.P.H., of the public health laboratories, London Hospital, London, Eng., said at a lecture which he gave on "Water Filtration in connection with public water supplies." There is one system of mechanical filtration which is worthy of mention, since it originated in England and does not entirely depend upon sand for efficiency, and is in use at several important towns. Possibly also the fact that the two towns in which it has been longest in use have the lowest death rates from typhoid fever may also justify me in selecting it for special mention; I refer to the Candy Filter.

The Candy Patent.

Breifly enumerated, the following advantages are claimed for the Candy Patent automatic compressed air and oxidizing system: (1) Low capital outlay, combined with low working expenses, as compared with other systems of filtration. (2) High chemical as well as bacteriological purity of the filtered water (a series of tests extending over several months, made by an important corporation, showed that, according to the corporation's analyst, the water treated by the Candy filters was clearer and better filtered than the water from the best sand beds. (3) The small quantity of water used for washing purposes. (4) The filters can be placed direct on trunk mains and so, practically, loss of head or fall can be avoided and in many cases the cost of pumping saved. (5) The filters are under direct control and simple to operate—all that is needed either for cleansing or working being the occasional turning off or on of the valves when required. (6) No coagulents have to be resorted to, either to effect chemical purification or to remove the bacteria.

The filters contain layers (five feet in thickness) of specially selected prepared and graded silicia, sand, grit and pebbles, together with the oxidizing and purifying material "oxidium," which is extremely porus, rustless and insoluble, and the invention of Mr. Frank Candy of 5 Westminster Palace Gardens, London, S.W. (the inventor also of the filtering material Polarite).

Both oxidium and polarite have powerful purifying properties, but a series of tests carried out by the eminent scientist and authority on water purification, Dr. J. C. Thresh before mentioned, shows that oxidium gives a still higher degree of purification than polarite.

The total gravity system, No. 5, is in my opinion so much in advance of the others, that I feel you ought to aim at securing this system. The partial gravtiy system No. 4 is next in order. The pumping system No. 3 in next to be prefer ed, and the remaining two, in my opinion, ought not to be considered, while any of the other three are possibly within reach of the municipality.

I lay no claims to infallibility. These suggestions are given simply for what they are worth. They are merely my honest expression of opinion. I have the honor to be, Sirs,

Your obedient servant,

R. B. OWENS, B.A., B.E., M.R., San. I.

From the "Journal."

REPORT FROM PROVINCIAL SANITARY ENGINEER ON EDMONTON'S WATER SUPPLY.

At the request of the City Council, the following additional report on the possibilities of the city water supply was submitted to the Council at its last meeting by Mr. R. B. Owens, the provincial sanitary engineer:

February 8th, 1909.

To the Mayor, Aldermen and Commissioners of the City of Edmonton.
Refer to 1402, 22.

Gentlemen,—

I have the honour to be in receipt of a copy of your resolution of the 3rd instant, in which you tender me a vote of thanks for the information contained in my letter of the 2nd instant, and in which you ask

me to furnish you with further information. I beg to gratefully acknowledge your vote of thanks, and also to state that I shall take pleasure in furnishing you with the technical information asked for at an early date. In this letter I shall endeavor to comply with your request for "other information on your water supply," asked for in your resolution, by making an analysis of your water supply problem, from a commercial standpoint, rather than from a scientific standpoint as adopted by me in my letter of the 2nd instant.

You will remember in my letter of the 2nd instant, I attempted in a broad way to estimate the amount of water which you were called upon to pump. That I did on the assumption that 75 gallons per head per day for domestic use, waste and industrial purposes, was a liberal allowance. In this letter I propose to go into the matter more in detail than it was possible in my last, which was intended to be a very general description of things, and to discuss this important question, taking as my basis of thought the amount of money which we do receive for our water, and attempting to deduce from that amount and our tariff the actual quantity of water, which we deliver to the public.

If you will refer to your annual report, pages 42 and 43, you will find there certain definite data as to revenue and expenditure for a period of eleven months. I shall for the purpose of these calculations convert these data into their corresponding amounts for a period of twelve months, thus:

Expenditure.

Power house		$23,600.00
Operation		6,615.00
Debenture interest and redemption		28,110.00
Maintenance		2,490.00
		$60,815.00

Revenue.

Water Rates		$13,900.00
Flat Rates	$35,350.00	
Building Rates	4,605.00	
Permits	257.00	40,210.00
		$54,110.00
Deficit for twelve months		6,705.00
		$60,815.00
Surplus at November 30th, 1907		$8,265.10
Deficit at November 30th, 1908		6,705.00
Net surplus at November 30th, 1908		$1,560.10

If you will refer to your Waterworks Tariff Sheet you will there find the rates at which the water was charged in order to produce the definite amounts shown on pages 42 and 43 of your annual report. Now knowing the actual amount of money received in rates, and the approximate rate per 100 cubic feet charged, it is possible to determine, accurately enough to cause one to suspect that there is something wrong what was the approximate amount of water for which MONEY WAS ACTUALLY RECEIVED, quite apart from the quantity pumped into the mains.

1. From the figures on the Tariff Sheet under the heading "Meter Rates," it is seen that eight cents per 100 cubic feet is as close as one can get to the actual charge made to those large consumers who use meters.

2. From the fact that 25 cents per 100 cubic feet is the rate for those who wish to use meters for quantities up to 5,000 cubic feet, we can infer the flat rate to stores, offices, small industrial places, etc., is about 25 cents per 100 cubic feet, as they have the option of either using the meter or accepting the flat rate.

3. For the purpose of deducing the charge per 100 cubic feet for water for strictly domestic use, from the flat rate charged dwellings, we shall assume an eight-roomed dwelling as the average, a six-roomed dwelling and under being charged the lowest rate; an eight-roomed dwelling with modern conveniences is charged $18, subject to ten per cent. discount if paid within ten days, i.e., $16.20 per year net; for such a dwelling, taking into consideration the fact that one or more of the inmates are out all day, and hence are using water in business places which have been already allowed for under 2, 25 gallons per head per day, or say 125 gallons per dwelling per day, is ample: i.e., 45,600 gallons per year or 7,320 cubic feet per year: therefore, the charge made per 100 cubic feet appears to be twenty-two and one-eighth cents. That this is a fairly close estimate is seen from the fact that 25 cents is the meter rate for amounts up to 5,000 cubic feet per day; therefore, if we charge our large consumers who use meters 8 cents per 100 cubic feet,

and receive in meter rates $13,900.00, we are evidently receiving from these payment for 17,380,000 cubic feet, i.e., for 108,400,000 gallons per year; and if we charge our small industries, stores and dwellings say an average between the 25 cents and the 22½ cents, say 23½ cents per 100 cubic feet, and receive in flat rates, building rates and permits $40,210.00 we are evidently receiving from these payment for $17,125,000 cubic feet, i.e., for 106, 700,000 gallons per year, i.e., a total of 215,100,000 gallons per year, i.e., say 590,000 gallons per day, i.e., we are actually receiving payment for very little over half a million gallons per day, quite apart from what we may be pumping into our mains. Now 590,000 gallons per day for 20,000 people is equal to 29½ gallons per head per day for domestic use, waste and indutrial purposes. Moreover, the superintendent of the new sewage disposal works, under my instructions, kept a record of the time taken to fill one of the new tanks. And from its capacity and the number of persons tributary to it, the quantity of sewage discharged appears to be 26.5 gallons per head, per day.

Also Mr. Keely under my instructions took ten gaugings of the Saskatchewan Avenue sewer last winter, and these averaged 34 gallons per head per day, of the population tributary to it; thus, we have from these two an average of 30¼ gallons per head, per day; and as this quantity likely contains a proportion of water for fire and sewer-cleansing purposes it is easy to see how very close our estimate of 25 gallons per head per day for strictly domestic purposes is; also, the average for domestic use, waste and industrial purposes in the United Kingdom is 30 gallons, so that our estimate of 29½ gallons is not very far off the mark.

Now, 17,380,000 cubic feet at 8 cents per 100 cubic feet and 17,-125,000 at 23½ cents per 100 cubic feet gives us an average price of 15.72 cents per hundred cubic feet, which we received during last year for our water (look carefully at your tariff sheet and see if this estimate appears to you to be far off the mark); but we made a deficit of $6,705 on our year's supply, so that we ought to have charged an average price of 17.67 cents, in order to have caused our books to balance evenly, i.e., it practically cost us 17.67 cents per hundred cubic feet to produce and distribute water last year.

Now from our expenditure we can readily see, if we apportion our debenture interest and redemption to the producing and the distributing systems in the ratio of 1 to 5, which is as near as we can get, owing to no separate records of these systems having been kept. We see that the cost of production is to the cost of distribution as 7 is to 8, i.e., it cost us last year 8¼ cents per 100 cubic feet to produce the water, and 9.42 cents per 100 cubic feet to distribute it, and this estimate of 8¼ cents for production is not far off being right, when we remember that in Strathcona where production has been kept separate from distribution the cost of producing is given me by Mr. McLean, the City Engineer, to be 7.85 cents per 100 cubic feet. But if it costs us 8¼ cents per hundred cubic feet to produce it last year, what will it cost us this year when we allow 5 per cent. interest on about $90,000 for this co-called extension, i.e., $4,500 interest; and in order that we may "manufacture" water $1,500 salary for an expert operator, and $2,500 salary for a chemist, and $5.50 per million gallons for alum, and $2 per million gallons for cost of unskilled labor, the price for the latter two being that quoted by the vendor of the filters. The cost per year for an amount of water equal to that delivered last year, viz., 215,100,000 gallons (due to the latter two items), would be $1,614.00, i.e., a total of $9,114.00 per year, i.e., the cost of production would be increased by 2.64 cents per 100 cubic feet, bringing our total cost of production in future to 10.89 cents per 100 cubic feet, i.e., our total cost for production and distribution is about to become 20.31 cents per 100 cubic feet, or about one third greater than last year.

If we made a deficit of $6,705.00 last year, what deficit shall we make this year? *It seems to me that one glance at our tariff sheet, and one at our annual report ought to be quite sufficient to convince anyone that we are not delivering three million gallons ger day, or anything approaching it, no matter how much we may he pumping into our mains. When we are delivering to the public three million gallons per day at 15.72 cents per 100 cubic feet our year's revenue will be $276,000.00 instead of the amount we received last year in revenue, viz., $54,110.00.

It is not necessary to take my figures for this; I simply give it for what it is worth. It is taken from your own published matter, and is the only documentary evidence which I have to hand to help me decide whether or not this so-called extension is an absolute necessity at present.

I have the honor to be,

Gentlemen,

Your obedient servant,

(Sgd.) R. B. OWENS, B.A., B.E., M.R., San. I.

*Municipal Annual Report Oct. 31, 1909, Page 53. Net Deficit $22,495.56.

From the "Bulletin," November 30, 1909.

HIGHLY RECOMMENDS PIGEON LAKE SUPPLY

Consulting Engineer John Galt Submits His Report on the Conditions Prevailing There—Continuity of Supply Has Been Amply Established by the Outflow This Year.

More than six months ago John Galt, C.E., of Toronto, was appointed by the City of Edmonton to make a full report on the proposal of Frank M. Gray to supply water to Edmonton and Strathcona by means of a gravity system from Pigeon Lake. He at once ordered the installation of weirs for measuring the output of the lake and also had forwarded to him all the data in connection with the system that had been gathered by the city engineering department.

Mr. Galt made an exhaustive study of the conditions largely in connection with the continuity of supply and his report is a most favorable one to the proposals. It has just been received by the city commissioners and was submitted to the council last night. It is as follows:

Mr. Galt's Report.

In compliance with your instructions, I have been carefully looking into the question of the availability of Pigeon Lake drainage area as a suitable source of water supply for your city and now beg herewith to report as follows:-

This area which is situated about 45 miles more or less to the southwest of Edmonton, comprises fully 100 square miles, of catchment surface, 40 per cent. of which covers the water of Pigeon Lake.

Although my calculations at first on the basis of a total annual average precipitation of 18 inches, after allowing for losses due to absorption and evaporation, made it appear certain that a continuous flow of about 29,000,000 imperial gallons per day could be got. I thought it best, in the interests of all concerned, to make a certainty, doubly safe and sure, and therefore recommended, as you know, that a weir be constructed and the measurements of actual run-off tabulated and compiled.

These measurements have been utilized in formulæ and a curve plotted, which I herewith attach, as fully illustrating and explaining better than I can do in words the whole situation in a nutshell.

You will note that the period of surplus run off from Pigeon Lake extends approximately from last April to first October, or six months in all, when it practically ceases and is dry for the other six months, or the balance of the year.

Late in Commencing.

We were rather late, unfortunately, in constructing the weir and beginning to take readings, as the surplus overflow had really commenced in the beginning of April, whereas our readings only started on the third of May. Still, I have assumed an approximate curve for April, rising from 0 to 30 millions daily flow line, so that the percentage of error if any, must be very small when reckoned in the total.

The precipitation for the year from October, 1908, to September, 1909, at Edmonton was equivalent to 14 inches of rain, doubtless one-fourth of which was in the form of snow, thus showing that last season was considerably drier than what the average for 20 years shows, viz., 18 inches. But how it compares with the driest on record is hard to say. With such a large storage supply in the lake the fluctuations over a number of years, including a cycle of dry and wet periods, would not disturb the continuity of average supply, as it would make up in the wet period just what was lost in the dry one.

Average Eighteen Millions a Day.

The variable plotted curve, as per diagram attached, which averages fully 16,000,000 gallons per day, for the year 1909, warrants the assumption that an average flow of 18 million gallons daily can be taken as a safe basis to go upon, or enough therefore for a district population of 200,000 people.

I take pleasure, therefore, in presenting this feature of available supply as a safe and proper foundation to go upon when considering and discussing the project from a practical engineering and financial standpoint.

The question of suitability of the water, from a sanitary standpoint, as to quality, is of first importance, but I relegate this to the provincial health authorities, who have in any case to report and pass upon it.

Good Water for Cities.

Prsonally, I believe it will be found to be good water for general domestic purposes, and as it can be secured and kept as a forest reserve, its purity can be maintained and no contamination ever threaten it.

It is a long way off, of course, and the cost of first initial expenditure cannot well be less than $2,000,000. Taking 8 per cent. to cover interest, sinking fund and operating expenses, etc., the annual charges would be $160,000. This would mean using say, five million gallons of water daily, at a rate of nine cents per 1,000 gallons, to meet expenses.

Now, what are the conditions? Your city at present must be using about two million gallons daily, and it is not unreasonable to assume that, at the end of, say, four years hence, which should easily cover the period of installation of such a system, the total consumption, including Strathcona, would in all likelihood about reach this amount.

Undertaking Profitable.

Above this amount, and as the years go on, the undertaking would be quite profitable, even at a considerably reduced rate for water; in fact, it would become a valuable investment for all time and well worth every dollar spent on it, even if it should ultimately run up to a total of $3,000,000 in making available the full supply for 200,000 people.

At the first go-off, it would hardly, perhaps, be advisable to make the supply main large enough over its entire length to deliver the full supply, but no doubt it would be a wise policy to make a long section of it, which would be under little pressure at the upper end, the full capacity leaving the balance to be duplicated in future years.

It must be understood from this report that I have not closely examined into an exact location for pipe line, also details of construction, necessary in such an undertaking, because same would involve a considerable amount of time and money and that the object of this report is merely of a preliminary nature to establish the feasibility of the project from an engineering standpoint.

Supply Can Be Supplemented.

There are other drainage lake districts to the west of Pigeon Lake which might be profitably utilized in the future to supplement Pigeon Lake and the policy of the council seems a wise one in view of the great strategical and geographical importance of Edmonton, to continue making investigations into all possible sources of water supply, not only for domestic use but for general power development in the interests of the people.

I think I have given your Honorable body all the useful information necessary to consider the project from any standpoint, but if I have omitted anything, or further information is desired, I shall be only too pleased to respond on hearing from you at any time.

I have the honor to be,

Yours obediently,

JOHN GALT,

Consulting Engineer.

Strathcona, September 21st, 1911.

MR. F. M. GRAY,
Edmonton, Alta.

Dear Sir:—
The sample of water submitted August 8th on analysis gives the following results in parts per million:

Hardness (Calcium and Magnesium Carbonate)	120— 8.4 gr. per gal.
Total Solids	182—12.7 gr. per gal.
Alkalinity (Calculated as Calcium Carbonate)	120— 8.4 gr. per gal.
Free Ammonia	.980—.069 gr. per gal.
Albuminoid Ammonia	.600—.042 gr. per gal.
Chlorine as Chlorides	1.6—112 gr. per gal.
Nitrates	.40—.025 gr. per gal.
Sulphates	No estimable amount.

CONCLUSIONS.

The above analytical results show this sample to be a moderately soft water, containing only temporary hardness. Its rather high ammonia content indicates the presence of considerable organic matter which, however, in view of the character of the environment of the source of the water, is probably not in itself of an objectionable nature. Consideration of the analytical figures and of the description of the source of the sample indicates that, in quality, it is well suited to municipal purposes, including boiler and domestic uses.

Yours obediently,
D. G. REVELL,
Bacteriologist.

Regina, August 17th, 1911.

Dear Sir:—
The sample of water forwarded by you from Pigeon Lake was duly received and has been analysed as requested. The report is as follows:

Water, clear and colorless.

Odor	Earthy
Chlorine as chlorides	.35 grains per gallon
Carbonates of Lime and Magnesia	8.4 grains per gallon
Sulphates of Lime and Magnesia	8.05 grains per gallon
Total solids	16.8 grains per gallon
Oxygen consumed	19.4 parts per million

This water is comparatively soft and is of good quality apart from the organic matter which it holds in suspension.

Examined bacteriologically this water is found to be free from contamination. The water should be suitable for domestic purposes even in its natural state but if passed through a filter the organic matter would then be taken out and the keeping qualities of the water would be greatly improved. I should be glad to examine other samples at any time.

Enclosed please find account for same.

Yours sincerely,
G. M. CHARLTON,
Bacteriologist.

FRANK M. GRAY, ESQ.,
Edmonton, Alta.

Edmonton, Alta., Jan. 30th, 1909

MR. F. M. GRAY,
Edmonton, Aita.

Dear Sir:—

The plans placed by you before the Provincial Board of Health this morning, for a system of water supply far the City of Edmonton, have been carefully considered by the Board, and, providing, that the conditions of the Public Health Act, as set out in clauses 23, 24 and 25, are camplied with and prove satisfactory, the Board will issue the necessary certificate to permit the construction and operation of such system.

The Board has much pleasure in expressing its high commendation of the proposed system.

Yours truly,
J. D. LAFFERTY, Chairman,
Provincial Board of Health.

THIS DATA IN CONNECTION WITH THE SCHEME WAS COMPILED ON JUNE 10, 1909

Area of Pigeon Lake is 37 sq. miles—23,680 acres.

Catchment area is 106 sq. miles—67,840 acres

Elevation of Pigeon Lake above highest point in Edmonton is about 600 feet.

One foot in depth of water on Pigeon Lake represents 6,426,250,000 imperial gallons.

One foot in depth of water on Pigeon Lake represents 17,600,000 Imperial gallons per day for 365 days.

18 inches of rainfall over the catchment area represents 27,615,500,000 Imperial gallons.

18 inches of rainfall over the Lake represents 75,600,000 Imperial gallons per day for 365 days.

One-half inch of rainfall per annum over an impervious cathcment area of the extent of this one represents 2,000,000 gallons per day for 365 days which is Edmonton's present consumption.

One and one-half inches of water on Pigeon Lake represents one year of Edmonton's present consumption.

One foot in depth of water on Pigeon Lake represents eight years of Edmonton's present consumption.

Since the weir has been installed the Lake has risen one foot.

There are indications on the piers underneath the bridge over Pigeon Creek which go to show that the Lake will yet rise at least eighteen inches which would represent twenty years of Edmonton's present consumption.

The Lake at present contains a quantity of water equal to two hundred years of Edmonton's present consumption.

The fact that there is discharged from the lake each year from two to three feet in depth over the entire surface combined with the fact that the lake discharges water during the winter season, go to show that even if it should not discharge water during a month or two in a very dry season, yet evaporation and percolation are amply provided for.

There has flowed over the weir at Pigeon Creek during the 30 days, May 3 to June 2, over 531½ million gallons.

There has flowed over the wier at Pigeon Creek during the 30 days, May 3 to June 2, an average of 17¾ " million gallons per day.

There has flowed over the weir at Pigeon Creek during the 30 days, May 3 to June 2, a quantity of water equal to 8¾ " months of Edmonton's present consumption.

Relief Map

on Exhibition at the
Imperial Shoe Store
Jasper Avenue and
2nd St., Edmonton

BULLETIN JOB PRINT